



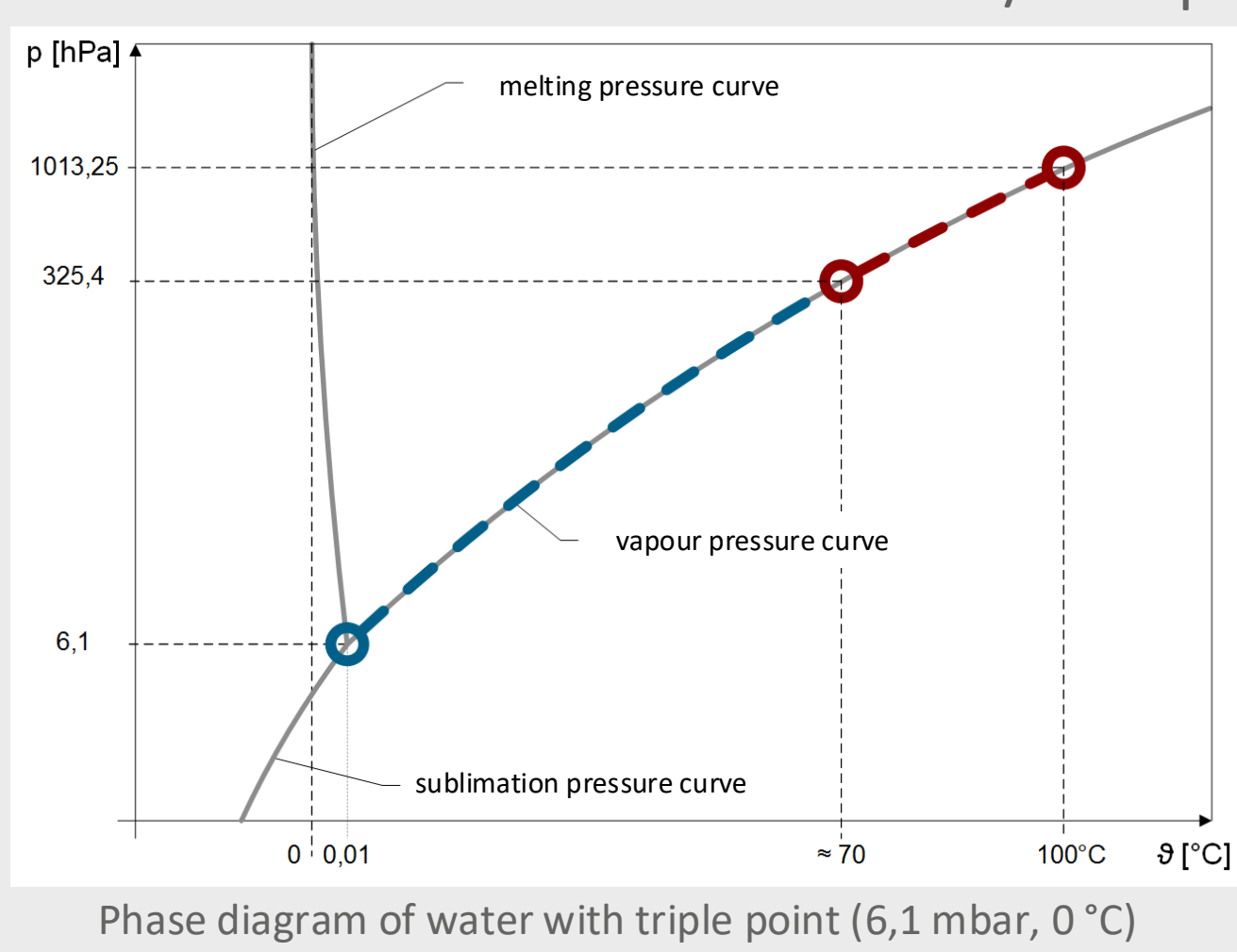
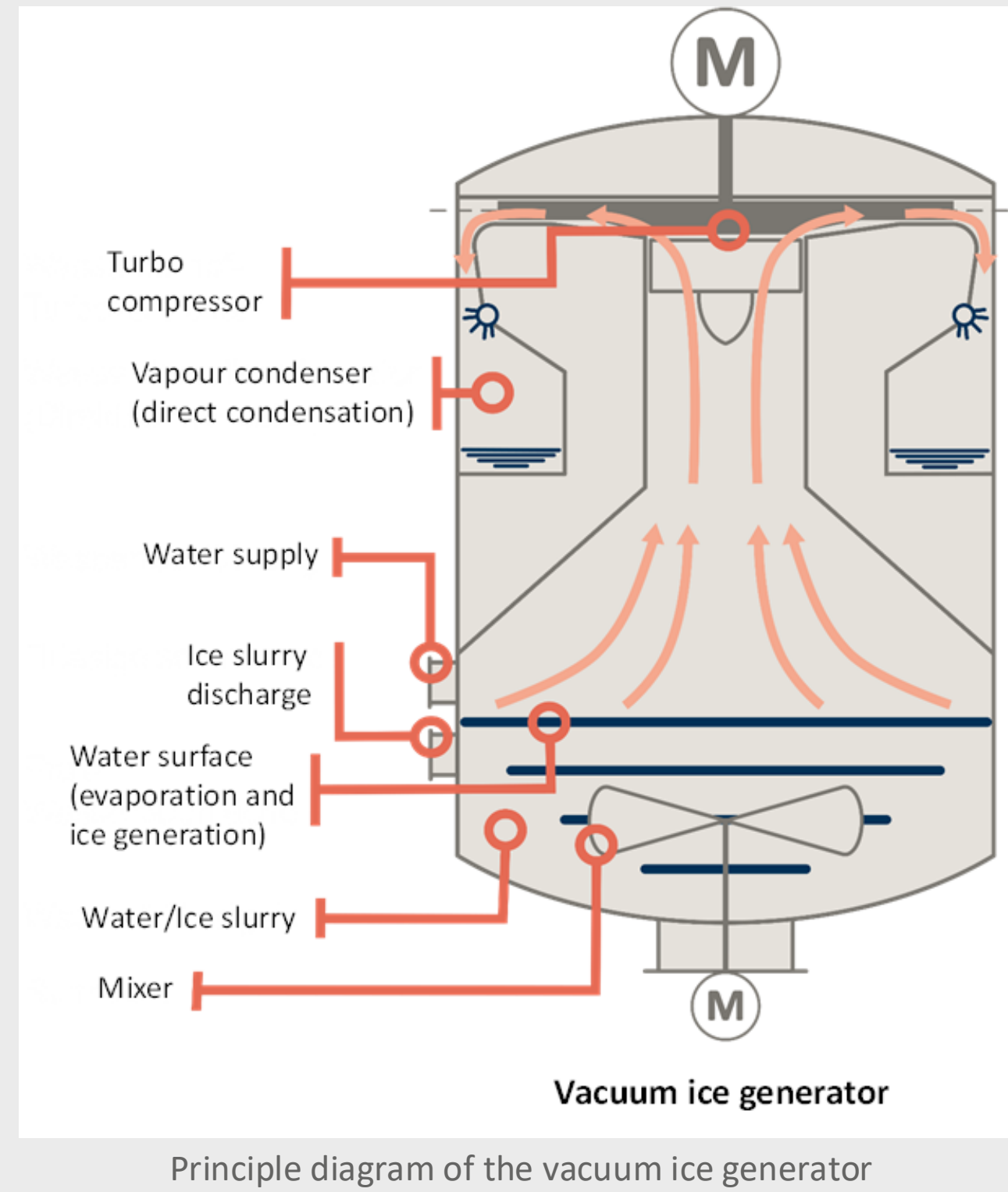
Testing and demonstration of a river water heat pump with partial freezing and district heating feed-in - **AQVA HEAT III**

T. Gubsch - Zittau/Görlitz University of Applied Sciences, Institute for Process Technology, Process Automation and Measurement Technology (IPM)
M. Safarik - Institut für Luft- und Kältetechnik Dresden gmbH (ILK)
F. Panitz - Fraunhofer Research Institution for Energy Infrastructures and Geotechnologies (IEG)



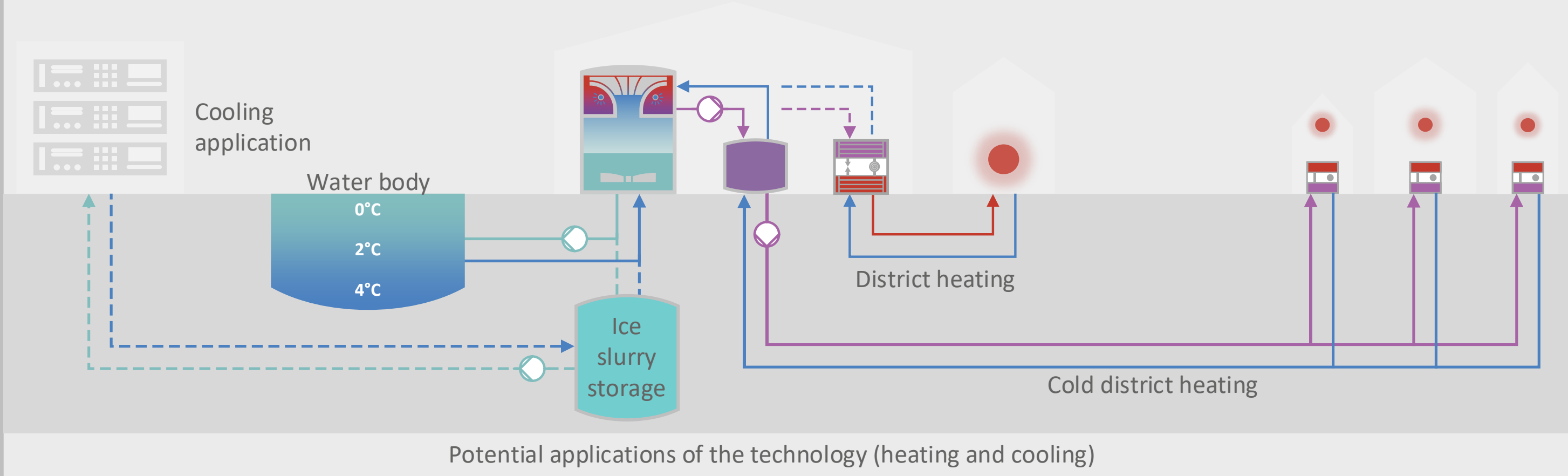
Principle of the Triple Point Process "Freezing by boiling"

- Water boils at 6 mbar and 0 °C
- Evaporation of water molecules at the water surface
- Energy is detracted from the surrounding liquid
- Other water molecules freeze and form ice particles
- A pumpable ice slurry is generated in the evaporator
- Water vapour is sucked from the ice generator by a turbo compressor
- Vapour is compressed and condensed at higher temperature directly
- Heat transfer to intermediate circuit/heat pump



Project content and aims

- Construction, testing, seasonal demonstration and optimisation of the overall system comprising water access, direct evaporator, heat pump and heat sink
- Automation of the complete system
- Water law approval procedure
- Aquatic ecological monitoring



Natural water body extraction

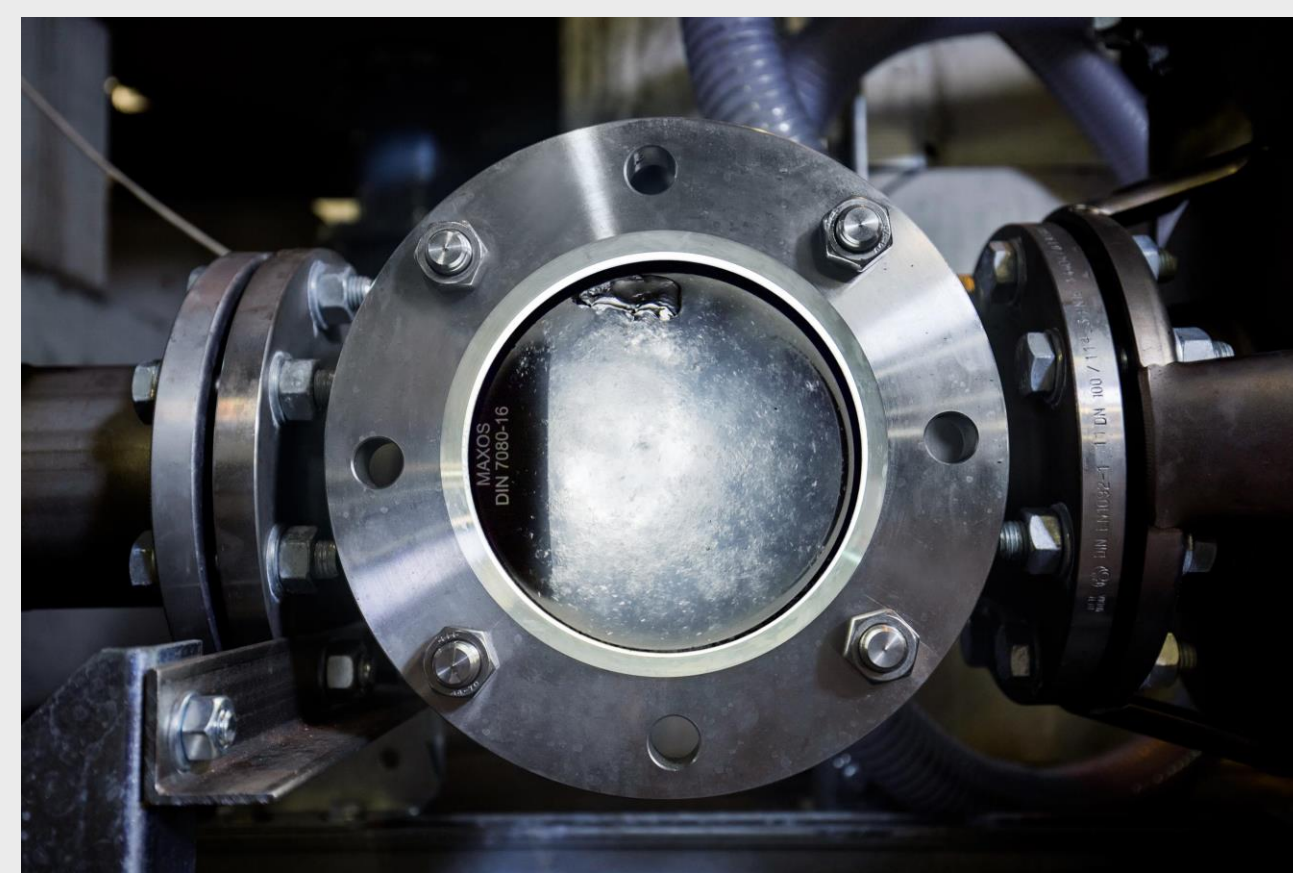


River: Mandau in the city of Zittau

- Heat extraction from water bodies (rivers and lakes)
- Temperature of the heat source (river water): 0...20 °C
- River water extraction up to 65 m³/h
- Operation in sensible-heat or latent „ice-slurry“ mode

Direct evaporator / ice slurry generator

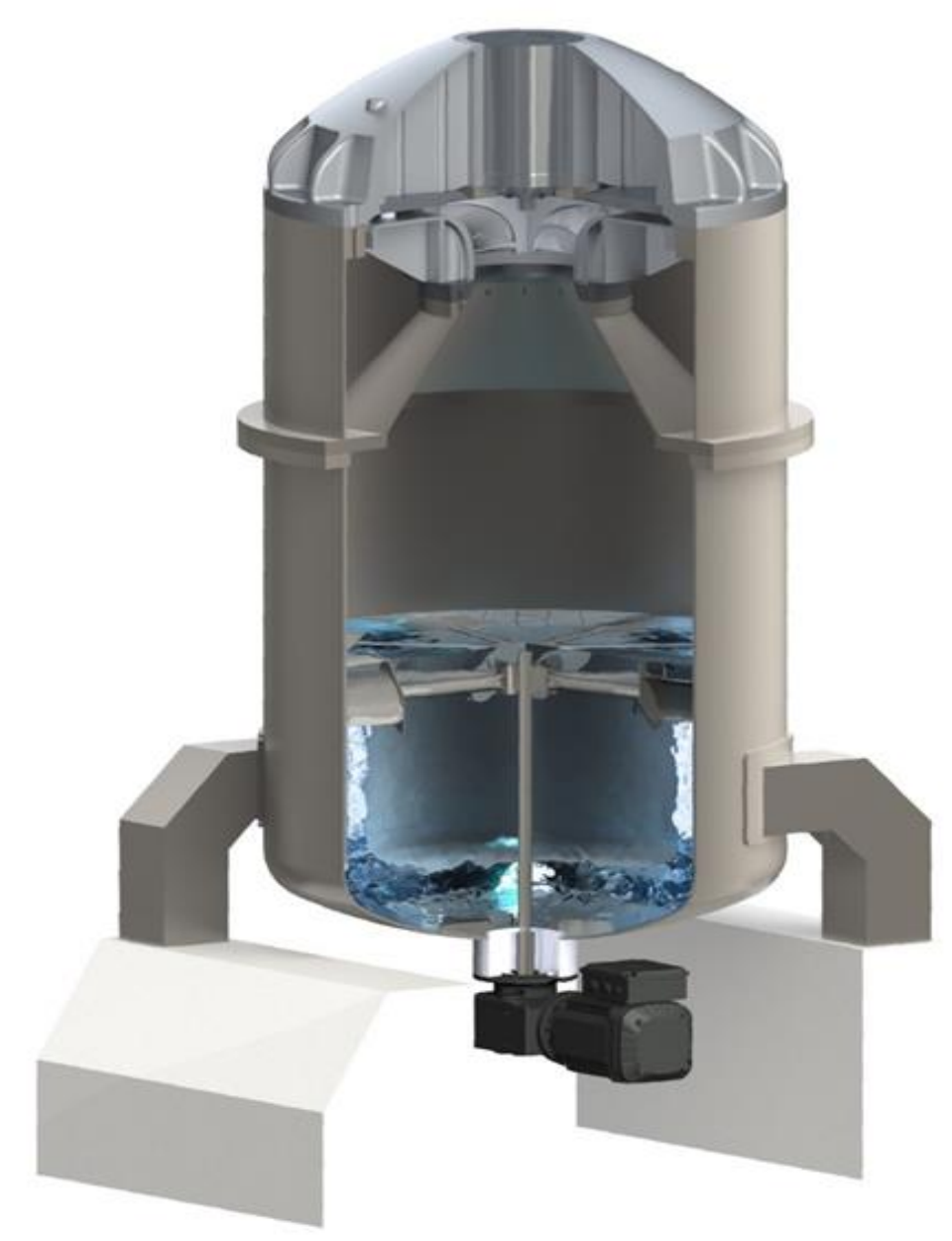
- Single-stage radial turbo compressor
- Refrigerant: water (R718)
- Evaporator: direct evaporation (agitated tank)
- Condenser: direct condensation (water spray)
- Evaporation temperature: -1...15 °C
- Condensation temperature: 10...25 °C
- Manufacturer: AQVA Synergy GmbH



Observation window in the return flow pipe (ice slurry)



Big evaporator (350 kW as heat pump)
(Source: AQVA Synergy GmbH)



Small evaporator (90 kW as heat pump)
(Source: AQVA Synergy GmbH)

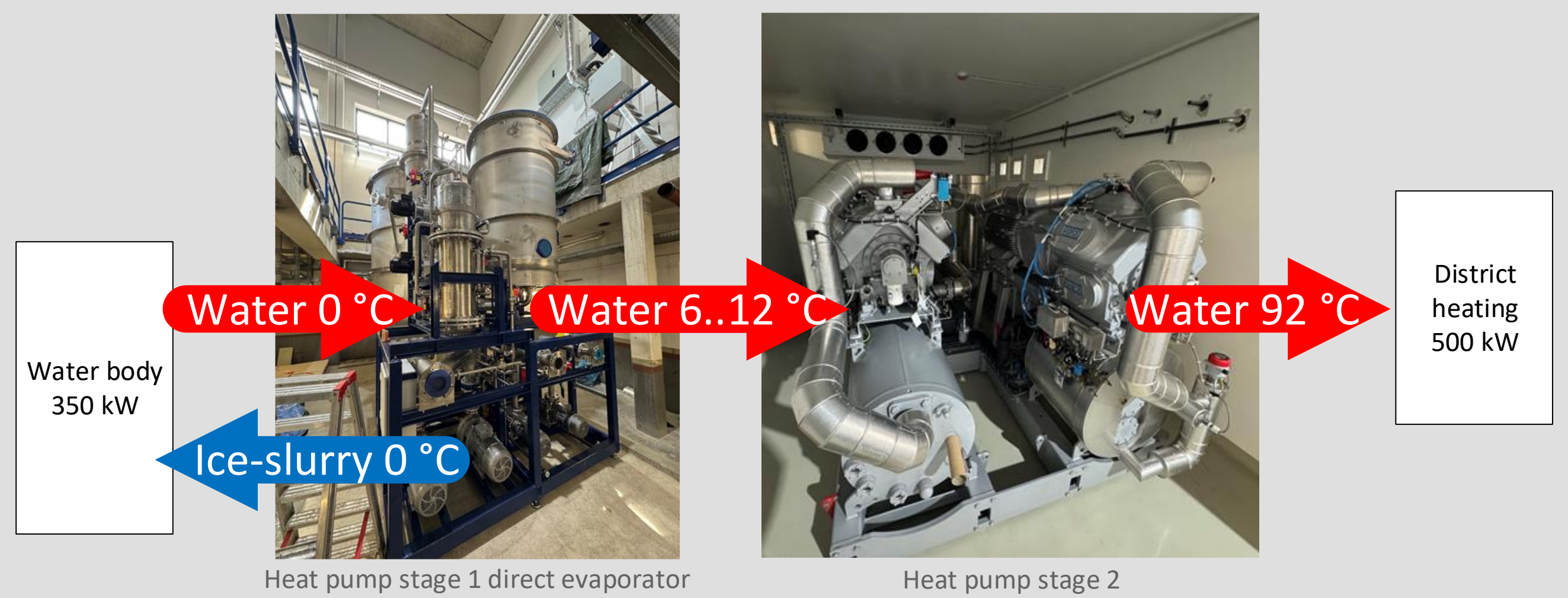
River water heat pump system „Big“ (500 kW)

Integration:

- Heat feed into the district heating network of the city of Zittau
- Heat capacity: 500 kW up to 92 °C
- Operation mode:
 - 55/75 °C (return temp. increase)
 - 55/92 °C (flow feed)

Second temperature lift:

- Two stage piston compressor
- Refrigerant: Ammonia (R717)
- Source temperature 6...12 °C
- Control range: 20...100 %
- Typ: DualPAC HPX 706 & SMC 106
- Manufacturer: Johnson Controls Denmark



River water heat pump system „Small“ (130 kW)

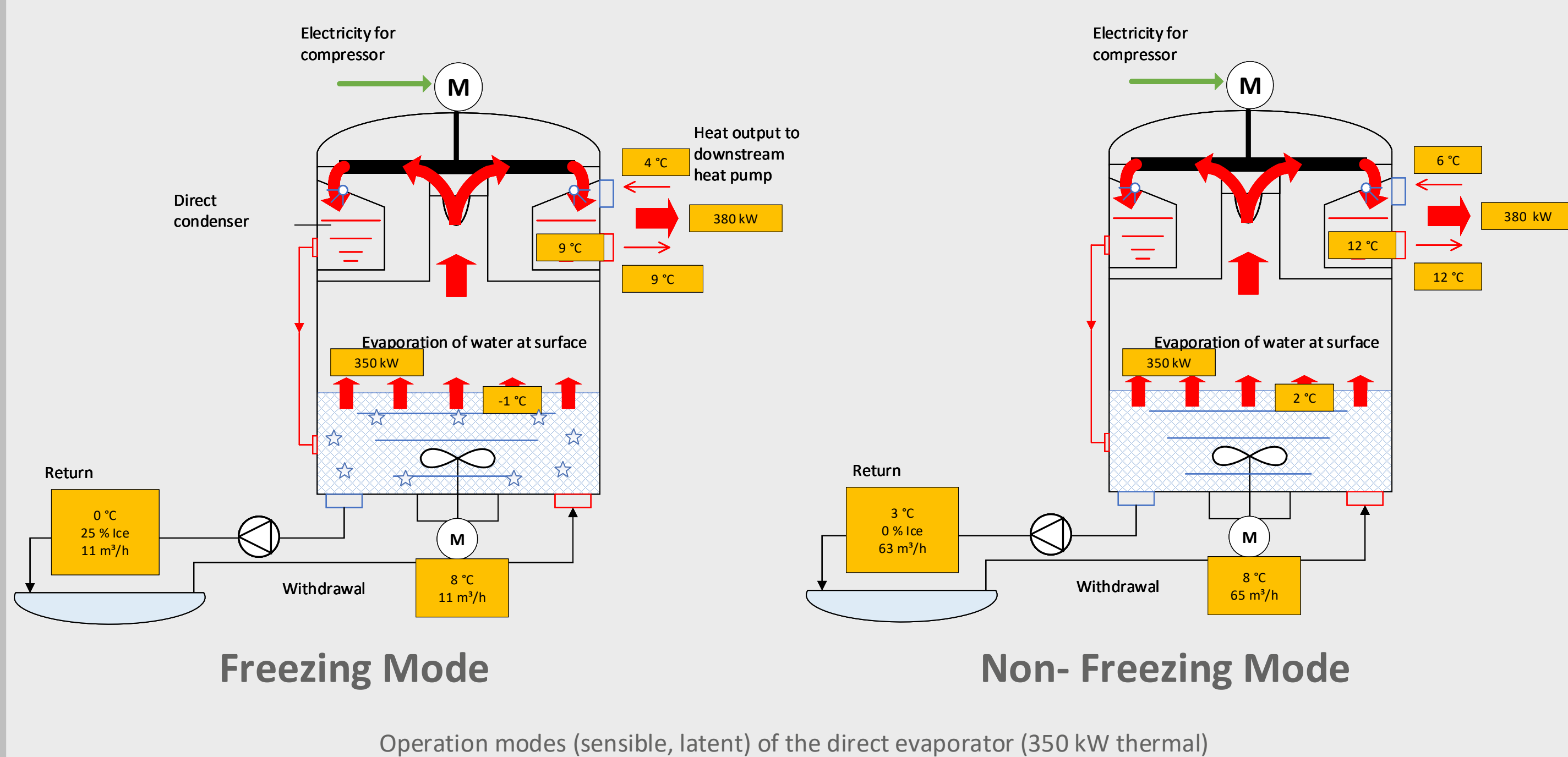
Integration:

- Direct integration in space heating systems of large buildings
- Heating capacity: 100 kW up to 70 °C

Second temperatur lift:

- 4-stage heat pump cascade
- Refrigerant: Propane (R290)
- Manufacturer: PEWO Energietechnik GmbH

Operation modes of the direct evaporator



Aquatic ecological monitoring

- Biological, chemical and physical monitoring
- Continuous oxygen and temperature measurement
- Temperature measurement area
- Requirements from the water law authorization

